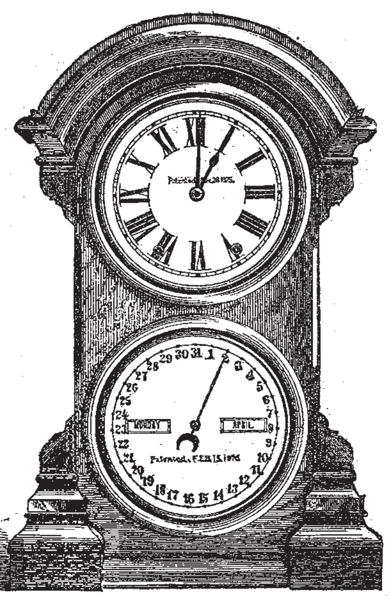
circumference from 1 to 31. Two openings on a horizontal diameter allow drums to show the month and day of the week respectively, and a central hand points out the day of the month. A cam, formed like the snail of an English striking-clock, but without the steps, is caused to rotate once in twenty-four hours by the clock movement, so that a pendant, resting on it, is raised through a space of about 1 inch in that period and allowed to fall, the weight being supplemented by the tension of a spiral spring; this is the sole connection between the calendar and clock. During the ascent of the pendant a detent passes over one tooth of a wheel fixed to the week-day drum, which is thus carried round through a corresponding interval when the release occurs. At the same time a precisely similar action, performed on a wheel fixed to the axis that carries the hand, causes it to advance one figure.

Just as the cam driven by the clock accomplishes the change from day to day, so a second cam on the central axis of the calendar alters the month; the detent, on being released, carries forward one tooth of a 12-toothed wheel. It remains to explain the device for allotting the requisite number of days to each month and correcting

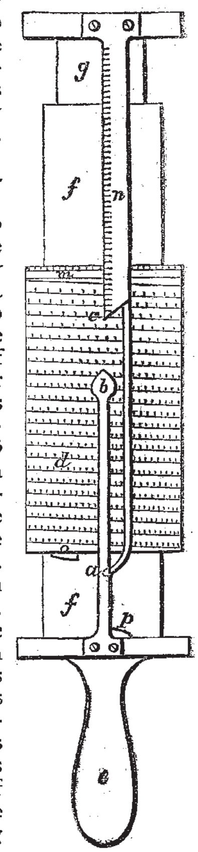


8-day Parlour Calendar, No. 4. Height 25 inches. Spring-Strike. 8-inch Dials.

for leap year. The axis of the month drum carries an irregular shaped cam, which may be conceived to be divided radially into twelve parts. Those arcs of the circumference that correspond to 31-day months are left untouched; 30-day months have their arcs filed away to the corresponding chord; and for February a depression is made equal to three times that of other months such as April. A light spring holds a bent arm against this cam, the arm being so placed that at the end of each short month it can ride on a metallic arc carried round with the hand; the acting length of this arc corresponds to one or three teeth of the dial-wheel if the 30th or 28th is the last day, and the arm entirely escapes it when thirty-one days are to be indicated. Whenever it is thus held out of its natural position, the arm prevents the check-spring that limits the movement of the dial-wheel from falling into its place, and the detent is thus enabled to advance the hand through two or four spaces instead of the usual one. An additional day is given in leap-year by a simple application of the well-known sun and planet wheel of Watt. The central fixed wheel is coaxial with the month-drum and has sixteen teeth; the planet-wheel, pivoted on the cam, has twenty teeth, and carries a sector of such a radius that, when superposed on the February depression, it diminishes the fall of the arm so that it rides on an arc corresponding to two teeth instead of three. It will be seen that the above numbers of teeth are so chosen that the wheel carrying this sector is only brought into an identical position once in every four (annual) rotations of the month-drum; the necessary correction is therefore effected.

SPIRAL SLIDE RULE[1]

THE method of multiplying and dividing by means of a rule was first introduced by Gunter about the year 1606 by the construction of a scale of two equal parts divided logarithmically, the readings being taken off with a pair of compasses. Oughtred about 1630 invented the rule composed of two similar logarithmic scales sliding in contact, but the difficulty of estimating the reading between two graduations then first became important. It is easy to see that it requires but little practice to place a graduation in one scale opposite to a position obtained by estimate between two graduations in the other scale, but it becomes a much more tiresome and uncertain process when both of the readings required to be placed in juxtaposition fall between two graduations on their respective scales. With practice, however, this operation can be effected with considerable accuracy provided the graduations are not too close together; hence to enable the calculations to be performed with a sufficient degree of approximation there has always been a desire to increase the scale and consequently the total length of the instrument. To attain this object and at the same time preserve the portable size of the instrument Prof. Everett designed his slide rule, but the range of this is now far surpassed by the invention by Prof. Fuller of the spiral slide rule.



The instrument can be readily understood from the accompanying figure.

d is a cylinder that can be moved up and down or turned round on the cylinder *ff*, attached to and held by the handle *e*. Upon *d* is wound in a spiral a single logarithmic scale. Two other indices, *c* and *a*, whose distance apart is equal to the axial length of the spiral, are attached to the cylinder *g*, which slides in *f* and thus enables the operator to place them in any required position relative to *d*. *o* and *p* are two stops which when placed in contact bring the index *b* to the commencement of the scale. *m* and *n* are two scales, one attached to the movable indices and the other to the cylinder *d*.

By the spiral arrangement the length of the scale can be made very great, and as only one scale is required the effective length is double that of an ordinary straight rule. The scale is made 500 inches, or 41 feet 8 inches long, and the instrument is thus equivalent to a straight rule 83 feet 4 inches long or a circular rule 13 feet 3 inches in diameter. The first three digits of a number are printed on the rule throughout the scale, much increasing the facility of reading off. The method of using the different indices will be best understood by examples. For multiplication—bring 100 to the fixed index *b* and place the movable index to the multiplicand,

[1] By George Fuller, M.Inst.C.E., Professor of Engineering, Queen's University, Ireland.

then move the cylinder so that the multiplier is at the fixed index. The product is read off at one of the movable indices, bearing in mind that the number of figures in the product is the algebraic sum of the number of figures in the multiplier and multiplicand, if it is not read upon the same index as the latter, but it is one less than that sum if read upon the same index. The use of the scales *n* and *m* is shown by the following: *n* being read from the lowest line of the top spiral and *m* from the vertical edge of the former. To find the value of 5^{13}: on placing *c* to 500 scale *n* reads ·68, and scale *m* ·01897, which gives ·69897 for the logarithm of 5. $\cdot 69897 \times 13 = 9\cdot 08661$. Next placing the cylinder so that it reads ·08661 on scales *m* and *n* the index *c* reads 12207, hence the required power is 1220700000 consisting of ten figures as required by the logarithm above. Where a considerable degree of accuracy is required we believe this slide rule will be found of much service, but it cannot compete on the one hand, on account of its somewhat cumbrous nature, with the ordinary patterns of slide rule for rough and ready work, or on the other with a table of logarithms for calculations requiring close approximation.

OUR ASTRONOMICAL COLUMN

A New Nebula.—Dr. Tempel, of the Observatory of Arcetri, Florence, notifies his discovery of a nebula on March 14 in a part of the heavens which has been most rigorously scrutinised in searching for these objects. For this reason it was at first supposed to be a faint comet, and was compared with the seventh magnitude following, W.B. XI. 305; but on March 16 its place was found to be unchanged. Dr. Tempel says it is properly a double nebula, with two small but distinct nuclei, distant from 15″ to 20″, and he adds the nebula Herschel II. 32, which is in the vicinity, was on both evenings much smaller and fainter than the new one. Herschel's nebula is caught at once in slow sweeping with a 6 or 7-inch refractor, so that an object to be very decidedly more conspicuous, must be within reach of ordinary telescopes, and it is hardly credible that its appearance can have long been as Dr. Tempel now describes it, without its being previously detected. Mr. Lassell's Catalogue of 600 new nebulæ discovered at Malta contains several in the immediate neighbourhood, so that the observer, Mr. Marth, could hardly have failed to have his attention called to the object in question, if then as visible as at present. Dr. Tempel's nebula is obviously worthy of immediate and continued observation; its position for 1879 is in R.A. 11h. 18m. 5s., N.P.D. 86° 1′·4, or it precedes the seventh magnitude above named 1m. 27s., nearly on the parallel. Chacornac, in his Chart No. 34, has a star 12·13 mag. within about 3′ from the above position, but shows no nebulosity; this circumstance is of itself sufficient proof that the nebula was not visible twenty-five years since. We would suggest that the position of this object relatively to the stars near it should be determined with all possible accuracy; it will be remembered that the centre of condensation in the variable nebula in Taurus has appeared to oscillate about the point where it was first remarked in October, 1852; or, to speak perhaps more correctly, nebulosity has at times been quite imperceptible in the original place, though apparent at a very short distance from it.

Brorsen's Comet.—In No. 2,254 of the *Astronomische Nachrichten* Dr. Armin Wittstein of Leipsic has given an orbit and ephemeris for this comet, founded upon a correction of the elements of Prof. Schulze by means of observations at Leipsic on March 19 and 26. There appears, however, to be error in the work; the new elements differing much from an observation on April 14, and so far as we can see, it is probable that the ephemeris for May, which has appeared in Nature, will be much nearer the truth than Dr. Wittstein's figures; at the same time it is to be remarked that the predicted elements require sensible correction, though not to such an extent as his calculations would indicate. Were it considered worth while, an orbit might be deduced from the observations already made at the present appearance, which would afford the means of following the comet closely during the remainder of its visibility, but the predicted elements with a correction to the time of perihelion passage, will doubtless suffice for finding the comet readily, as long as it is within reach.

Re-observation of Tempel's Comet, 1867 II.—In a communication to the Paris Academy it is announced that the comet of short period discovered by Dr. Tempel in 1867, and observed again at its return to perihelion in 1873 after experiencing heavy perturbation from the action of Jupiter, was found once more by its original discoverer, at the Arcetri Observatory on April 24. At 14h. 30m. Florence mean time, its R.A. was 16h. 50m. 59s. and its declination 13° 32′ south, so that its position corresponds nearly with that given in the first of M. Raoul Gautier's three ephemerides in *Astron. Nach.*, No. 2,242, in which the perihelion passage is assumed May 6·9416 Berlin M.T. Dr. Tempel says he had searched for it in vain during the rarely fine nights of February and March. The comet is faint and diffused, with a granulated appearance about the centre, and 2′ in diameter. This granular characteristic of comets, by the way, is one which has been frequently noted by Dr. Tempel, and which other observers do not appear to recognise so often. He directed particular attention to it when announcing his discovery of the comet of the November meteors, 1866 I.

If the perihelion passage of the comet 1867 II. be assumed to take place, 1879, May 6·9537 M.T. at Greenwich, and the mean diurnal motion = 593″·184, with the other predicted elements of M. Raoul Gautier, it is probable that the comet's position will be given very nearly during its present appearance. The co-ordinate constants in his orbit, for apparent equinox of June 1, are:—

$$x = r\,[9\cdot 99389],\ \sin.\,(v + 328^\circ\ 2'\cdot 4),$$
$$y = r\,[9\cdot 95727],\ \sin.\,(v + 242\ 33\cdot 4),$$
$$z = r\,[9\cdot 65727],\ \sin.\,(v + 218\ 41\cdot 7).$$

GEOGRAPHICAL NOTES

The steamer *Nordenskjöld*, Capt. Sengstake, belonging to Herr A. Sibiriakoff, is almost ready to sail from Gothenburg for Behring Straits, *viâ* the Suez Canal, to search for the *Vega*, along with the *Jeanette*, belonging to Mr. Bennett, of the *New York Herald*. Herr Gregorieff, of the St. Petersburg Geographical Society, sails with the *Nordenskjöld*. Herr Sibiriakoff is sending off two coast searching parties to Behring Straits, one from Nischni Kolymsk and the other from the mouth of the Anadyr.

The current number of the Royal Geographical Society's monthly periodical contains ample evidence of the good work which is being done by our missionaries towards making geography. Dr. James Stewart contributes an account of the second circumnavigation of Lake Nyassa, Dr. Laws a report of his journey along part of the west side of that lake, and Mr. G. Blencowe notes on the physical geography of Zululand and its borders, based on nineteen years' experience on the Natal and Transvaal frontiers. The geographical notes are fairly good, the more important being those which describe a new route from the Caspian to Kungrad, and recent explorations in Persia and Central Australia, but we cannot refrain from expressing our surprise that in a periodical, which ought to be the leading authority on geography, more space is not devoted to this department, the most important of all, for therein should be recorded brief accounts of all that is being done in the way of travel and exploration throughout the world. It will interest many of our readers to learn that the full text of